



Red Blood Cell Distribution Width as an Old and New Marker in Various Vascular Diseases

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Received date: April 21, 2017; Accepted date: May 8, 2017; Published date: May 11, 2017

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Abstract

Red blood cell distribution width (RDW) is the quantitative measure of anisocytosis showing the variability in size of the circulating erythrocytes. Generally, higher RDW reflects increased red blood cell destruction such as hemolytic disorders and nutritional deficiency including iron, vitamin B12 and folate deficiency. Recently, several studies showed a strong independent association between higher RDW and the poor prognosis in various vascular diseases such as heart, brain and kidney. This review will refer the underlying mechanisms of the beneficial prognostic marker of RDW in those diseases.

Keywords: Red blood cell distribution width; Prognosis; Vascular diseases

Mini Review

Red blood cell distribution width (RDW) is a quantitative measure of anisocytosis showing the variability in size of the circulating erythrocytes. In general, higher RDW reflects increased red blood cell destruction such as hemolytic disorders and nutritional deficiency including iron, vitamin B12 and folate deficiency. RDW have been mainly used in hematology thus far.

Recent studies showed a strong independent association between higher levels of RDW and the risk of adverse vascular outcomes in patients with various vascular diseases such as heart, brain and kidney [1-3]. However, the underlying mechanisms of the beneficial prognostic marker remain to be unknown. Red blood cell transports oxygen to the tissue such as peripheral muscle. Increased RDW signify increase red blood cell with incomplete oxygen binding with hemoglobin such as premature erythrocyte or iron deficiency anemia. This is thought that higher levels of RDW may affect oxygen transport capacity resulting in adverse clinical outcomes [4].

In the issue of the journal, Nishiyama et al. investigated relationship with RDW and peak oxygen uptake or exercise training effect in patients with coronary artery disease (CAD) [5]. In the present study peak oxygen uptake increased and RDW decreased before and after exercise training, significantly. Additionally, significant inverse correlations were observed between RDW and peak oxygen uptake before and after exercise training, respectively. These correlations were significantly stronger after exercise training than before exercise training. Previous study has shown that higher levels of RDW were related to impaired exercise capacity and exercise training decreased RDW in patients with chronic heart failure [6]. Although Van Craenenbroeck demonstrated effect of exercise training on peak oxygen uptake and RDW, the possible mechanisms for change in RDW before and after exercise training did not investigated [6]. The present study showed a significant correlation between changes in RDW and changes in erythropoietin concentration before and after exercise

training. These findings suggest that the variability of RDW was induced by erythrocyte proliferation in the bone marrow. Accordingly, it is possible that exercise training decreased RDW leading to increase oxygen binding with hemoglobin and oxygen delivery, and improved exercise capacity. As a result, an increase of oxygen delivery may cause negative feedback on erythropoietin concentration and a decrease in erythropoietin concentration after exercise training.

Possible mechanisms underlying the beneficial effects of exercise training on RDW may be considered. Generally, exercise training in patients with CAD decreases proinflammatory cytokine production and induces inducible nitric oxide synthase expression and antioxidative effects, leading to enhanced erythroid proliferation in the red bone marrow. Additionally, exercise training altered erythrocyte deformability and decreased the abnormality ratio of erythrocyte shape, and increased 2,3-diphosphoglycerate concentration of red blood cell, resulting in enhancing oxygen delivery [7-9]. Thus, several mechanisms for the effects of exercise training on RDW may be studied.

Exercise training increases aerobic capacity and exercise tolerance, and improves prognosis in patients with CAD. The present study provided the first demonstration that exercise training effect on the change in relationship between peak oxygen uptake and RDW, and decreases RDW in association with decreased erythropoietin concentration in patients with CAD. Although further investigations are needed whether this mechanism could be applied to other diseases, RDW may be one of the beneficial prognostic markers in patients with vascular diseases.

References

1. Isik T, Ayhan E, Kurt M, Tanboga IH, Kaya A, et al. (2012) Is red cell distribution width a marker for the presence and poor prognosis of cardiovascular disease? *Eurasian J Med* 44: 169-171.
2. Danese E, Lippi G, Montagnana M (2015) Red blood cell distribution width and cardiovascular disease. *J Thorac Dis* 7: E402-411.
3. Shah N, Pahuja M, Pant S, Handa A, Agarwal V, et al. (2017) Red cell distribution width and risk of cardiovascular mortality: Insights from

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- National Health and Nutrition Examination Survey (NHANES). *Int J Cardiol* 232: 105-110.
4. Felker GM, Allen LA, Pocock SJ, Shaw LK, McMurray JJV, et al. (2007) CHARM investigators. Red cell distribution width as a novel prognostic marker in heart failure: data from the CHARM Program and the Duke Databank. *J Am Coll Cardiol* 50: 40-47.
 5. Nishiyama Y, Niiyama H, Harada H, Katou A, Yoshida N, et al. (2016) Effect of exercise training on red blood cell distribution width as a marker of impaired exercise tolerance in patients with coronary artery disease. *Int Heart J* 57: 553-557.
 6. Van Craenenbroeck EM, Pelle AJ, Beckers PJ, Possemiers NM, Ramakers C, et al. (2012) Red cell distribution width as a marker of impaired exercise tolerance in patients with chronic heart failure. *Eur J Heart Fail* 14: 54-60.
 7. Zhao J, Tian Y, Cao J, Jin L, Ji L (2013) Mechanism of endurance training-induced erythrocyte deformability in rats involves erythropoiesis. *Clin Hemorheol Microcirc* 53: 257-266.
 8. Schmidt W, Maassen N, Trost F, Boning D (1988) Training induced effects on blood volume, erythrocyte turnover and haemoglobin oxygen binding properties. *Eur J Appl Physiol* 57: 490-498.
 9. Green HJ, Jones LL, Hughson RL, Painter DC, Farrance BW (1987) Training-induced hypervolemia: lack of an effect on oxygen utilization during exercise. *Med Sci Sports Exerc* 19: 202-206.